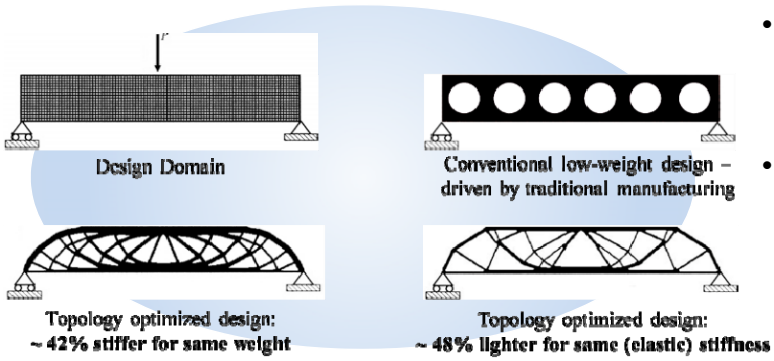
Topology Optimization

S&T Campaign: Materials Research
Manufacturing Sciences

Raymond Wildman, (410) 306-2232
raymond.a.wildman.civ@mail.mil

Research Objective

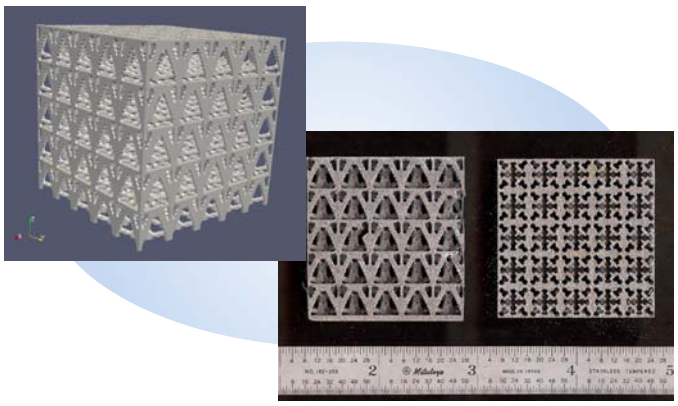
- Develop advanced topology optimization (TO) methodologies for design of multi-functional multi-material (MFMM) components
- Enhance TO with concurrent multiscale modeling, multiobjective topology optimization, and realistic manufacturing constraints and models



Topology optimization vs. traditional design

Challenges

- Accurate, but efficient forward models for a large set of problems: Structural, EM, thermal, etc.
- Better topology optimization algorithms for multiscale, multimaterial designs
- Computational requirements are burdensome for large-scale problems



Truss designed for compression

ARL Facilities and Capabilities Available to Support Collaborative Research

- General topology optimization software framework
  - Extensible topology representations
  - Extensible optimizers
  - Extensible objective functions
  - Community source project on forge.mil
- Extensive additive manufacturing capabilities
- Projects focused on
  - Additive manufacturing
  - Multifunctional/multimaterial designs
  - Fatigue-resistant designs (VTD)
- Facilities
  - MTS Servo-hydraulic mechanical testing machines
  - Laser cutters
  - Dimension Elite 3D printer
  - Objet Eden 260VS
  - Stratasys Fortus 400 FDM (3D Printer)
  - Wind tunnel

Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- Large compute clusters
- Antenna testing facilities
- Additional additive manufacturing capabilities, especially multimaterial manufacturing
- Novel methods to improve computational efficiency of optimization
  - Derivative-free optimization
  - Novel reduced data topology representations
  - Efficient forward solvers
  - Highly parallel solvers and optimization algorithms
- Novel applications for topology optimization